ANKE Acceptance for the Reaction $pp \to dK^+\bar{K}^{0*}$

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In 2001 and 2002 experiments to study the reaction $pp \to da_0^+ \to dK^+\bar{K}^0$ at $T_p = 2.65$ GeV and $T_p = 2.83$ GeV have been carried out at ANKE (see Ref. [1]). In principle, the analysis of the second data set at higher beam energy could be done in the same way as the lower data set (see Ref. [2]). However, it turned out that the acceptance correction method applied before caused problems due to the larger available phase space for the final-state particles.

The 2.65 GeV data have been acceptance corrected with a four dimensional matrix which was built from four independent variables. The binning has been chosen such that in total 500 cells were obtained, fine enough to reconstruct the target distribution model-independently and large enough that there were few acceptance holes. However, the accessible Q range at T_p =2.83 GeV is about twice as large and it is not possible any more to construct a suitable matrix. Thus, it was necessary to develop a new method.

This new method is based on the findings for the older data, namely that the data are well described by the assumption that only s- and p- wave contribute while larger partial waves are suppressed due to the nearness of the threshold. Under this assumption the initial target distribution is "known"; only the corresponding 6 coefficients in the amplitude need to be determined (see Ref. [1]). Since the acceptance strongly depends on the initial distribution, the assumed target distribution has been described with the above ansatz with six coefficients and has then been tracked through the ANKE acceptance with the help of GEANT. In order to safe CPU time, the acceptance of ANKE has been projected in two three-dimensional grids, each containing the momentum components p_x, p_y and p_z. The first grid is for the side detection system where the K^+ mesons are identified, the second is used for the faster deuterons which are detected in the forward system. The grid cell size of each component has been chosen such that it roughly reflects the resolution in this observable. The acceptance for any cell has been determined from 40–50 initial events and is the ratio of detected to started events. For the K^+ mesons the decay probability of each cell has been calculated and multiplied with the corresponding acceptance. The deviation of simulations and generated events weighted with the acceptance determined event-by-event from the grid is below one percent.

In order to fit the partial wave coefficients, a high statistics sample of phase space events has been generated, the acceptance was determined from the grid for each event as a weight, and the amplitude was calculated also event-wise as a weight. The coefficients were then varied such that the χ^2 of the obtained distribution and the experimental distribution (which was corrected for detector efficiencies) became minimal. The distributions with the minimal χ^2 are displayed in Fig. 1. The corresponding target distribution is shown in Fig. 2. The clear advantage of the fit method is that a sixth distribution ($\cos(pt)$) can be reconstructed and that the angles do not have to be mirrored as it was necessary with the matrix method to avoid acceptance holes. In addition, the data have been fitted kinematically before the acceptance correction, thus there are no longer events outside the kinematical limit, as it was the case, *e.g.* at low masses in $m(K\bar{K})$.

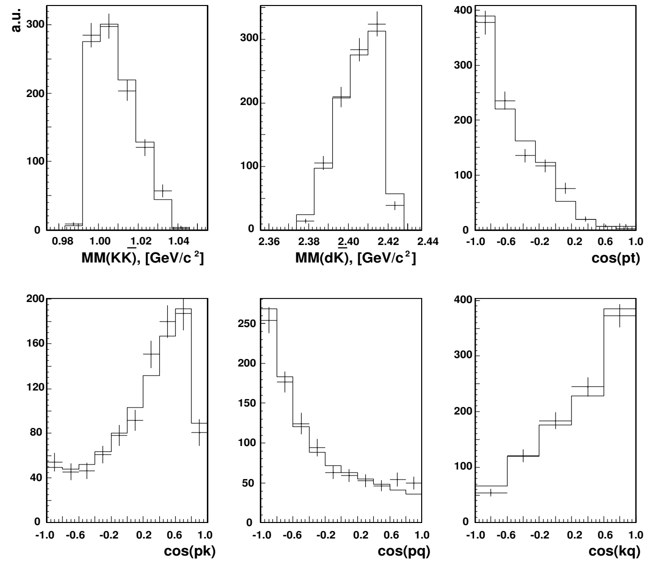

Fig. 1: Best fit of acceptance uncorrected data at $T_p = 2.65$ GeV. For the meaning of the observables, see Ref. [1].

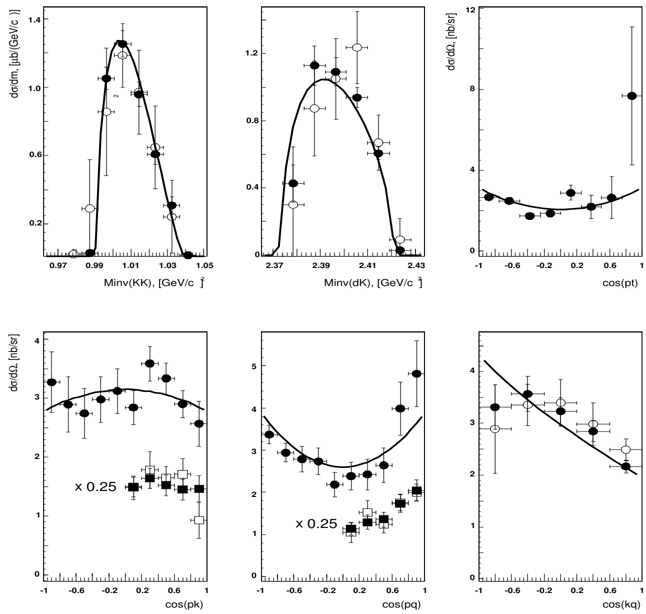

Fig. 2: Angular and invariant mass distributions for $T_p = 2.65$ GeV. The black dots with statistical error bars correspond to the data which are corrected with the fit method, the open dots with statistical and systematic error bars correspond to the data with matrix acceptance corrections. The uncertainty for the matrix method is larger due to the larger matrix cell sizes. Two angles are scaled and mirrored to compare with the published representation ([2]).

References:

[1] A.Dzyuba et al., contribution to this Annual Report.
[2] V.Kleber et al., Phys. Rev. Lett., **91**, 172304 (2003)

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